AIMS Energy, 4(3): 481-503.
DOI: 10.3934/energy.2016.3.481
Received: 31 December 2015
Accepted: 27 March 2016
Published: 01 April 2016

http://www.aimspress.com/journal/energy

Review

Energy and low carbon development efforts in Ghana: institutional arrangements, initiatives, challenges and the way forward

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Abstract: Over the years, Ghana has invested considerable effort and resources together with international partners to develop the energy sector and to mainstream energy low carbon pathways into national development plans. Low carbon development (LCD) provides a good opportunity, of not only building upon earlier energy and climate change local processes and structures but also help to mainstream low carbon agenda in economic activities and national development plans. For this to work however, require efficient institutions and effective institutional arrangements. Based on extensive literature analysis, personal communications and inputs from stakeholders, the paper highlights the key institutional arrangements, their interactions, challenges and proffers recommendations for improvements. To improve energy and low carbon development effort from the perspectives of institutional structures, would require, clearer institutional mandates, continuous improvements in institutional coordination (intra and inter), capacity and skills development, sustained visibility of the essence of energy and LCD at high political levels as well as engagement by civil societies. Equally important are the issues of finance, data availability and quality, monitoring and evaluation.

Keywords: Energy; low carbon development; institutional structures

1. Introduction

In the past two decades, climate change issues have received high attention and commitments in Ghana. Although Ghana's contribution to global GHG emissions is very low, the direct negative impacts of climate change on its economy can be far reaching. Ghana has largely experienced stable and consistent economic growth since 1960. The size of the Ghanaian economy has expanded with the GDP increasing from USD 1.2 billion in 1960 to USD 38.6 billion in 2014 in real terms [1]. After rebasing, the economy in 2010, Ghana became lower middle-income. The doubling of the size of economy has been attributed to the discovery oil and gas resources which has introduced additional revenue stream since 2010. Nonetheless key sectors of the economy are sensitive to the impacts of climate change.

The country appears committed in defining the vision of the future economic transformation. The transformation programme is not only anticipated to focus on pursuing socially-inclusive green growth, it also provides specificity on how such growth scenario would happen along less carbon-intensive trajectory. Particularly with respect to Ghana's commitment to climate proof its economic development, it has engaged itself to pursue the following: (a) at the international level, it signed the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and ratified it in 1995, (b) Ghana believes that there presently exist in the world, knowledge and technologies that could be effectively harnessed to help Ghana to develop via low carbon pathway without having to pursue the conventional development route associated with high greenhouse gas (GHG) emissions and (c) effectively mainstreaming low carbon development strategies (LCDS) into its development planning would be the surest means to ensure that it trickles down to the lowest possible levels of development.

Ghana's national medium term development framework provides the overall vision and strategies for the coordination of how the economic transformation will take place in a consistent manner. The national climate change policy gives specific government strategies on how its climate change agenda will be translated into actionable measures within the national development context. Therefore mainstreaming low carbon development strategy (LCDS) into development structures would be a positive signal for greater buy in. The benefits of using the existing structures for mainstreaming offer greater visibility and opportunity assimilation. But what drive the development structures are "suitably capable institutions".

1.1. Low carbon development and development perspectives

Ghana's low carbon development agenda encompasses its energy agenda. Although there is a strong recognition of 'climate friendly' development options in national development planning reports [2,3], a lot still remains to be achieved. LCD is a forward-looking national economic development plan that encompasses low-GHG emission aspirations [4]. Many developing countries are making efforts to voluntarily to commits to reducing CO_2 emissions in a way that development takes place without compromising its primary objective of reducing poverty. Although bigger emphasis of low LCDs is to ensure that development takes place conscious of the opportunities for reducing greenhouse gas emissions, it also offers chance for developing countries to showcase their contributions to the global collective efforts to mitigate future climate change.

Because LCD is at the center of the changing economic development, it is important that, it ably responds to the economic, social and environmental needs of the country in an integrated manner. Apart from the fact that LCDs could catalyze greater alignment of economic transformation to low carbon trajectory, the rapidity of the transition must not overtake the pace for growth depending on the national circumstances of the country. The emphasis on accelerating LCD transition beyond its natural progression could be prohibitive and counter-productive to development gains. The LCDs pathway becomes more incentivize when there is demonstrable evidence that the business-as-usual situation is no more sustainable option for economic development. For example in the electricity sector in Ghana, if the share of natural gas for thermal generation increases to the expected 50% by 2016, the implications for energy security and GHG intensity reduction would be win-win.

The study reported here seeks to highlight the institutional arrangements in Ghana for climate change mitigation and low carbon developments and their interactions. It also showcases past and ongoing LCD activities in Ghana. Finally, it highlights current challenges associated with establishing LCD and proposes suggestions on how to overcome the hurdles so as to positively advance low carbon development. It builds on earlier study by the Environmental Protection Agency (EPA) [5] and more recently the work [6] by UNEP/UNEP DTU Partnership in Ghana via the Facilitating Implementation and Readiness for Mitigation (FIRM) project.

In Ghana, recommendations to mainstream aspects of LCD into the existing development structures received a lot prominence in the latest national planning documents such as the Ghana Share Growth and Development Agenda (GSGDA) [2] and the National Climate Change Policy (NCCP) [3]. However, specific LCD aspects in national plans seem inadequate with regards to lacking budgeting, appropriation, implementation, monitoring and evaluation components as well as clarifications in institutional arrangements.

The mainstreaming seeks to ensure that in the articulation of economic development priorities -in the GSGDA into the sectoral and medium-term development plans—low carbon development opportunities are given the required attention. It is however hoped that attempts to mainstream LCD will gradually trickles internally within (*intra)* the various national developments, institutions and related organizations as well as *inter* institutions/organizations. Examples of the national development institutions comprises of the government ministries, departments and agencies (MDAs) while the related organizations includes the Metropolitan, Municipal and Districts Assemblies (MMDAs).

Effective institutional arrangement is a key driver for mainstreaming LCDs into development structures. Project Catalyst [7] has suggested that suitable and appropriate institutional arrangements are essential pre-requisites for achieving sustained, successful actions towards low carbon growth. A key benefit of having public institutions with positive orientation for low carbon development is the early 'buy-in' incentive it provides. The 'buy-in' by Ministries, Department and Agencies (MDAs) and Metropolitan, Municipal and Districts Assemblies (MMDAs) are crucial to the success of any low carbon development. This is because the model of the public administration structure in Ghana is such that whiles some MDAs coordinate and regulate others such as the MMDAs practically make direct investments. Therefore, understanding of institutional structures and how they interact is a key ingredient to designing governance models for any form of low carbon development. This is because, the success of any low carbon development plans does not only lie with good policies and measures, but also crucially linked with having efficient institutional structures that make things work.

2. Approaches/methodology

Desktop study and interviews with key stakeholders in the low carbon development space were the two main approaches adopted for this study. Where necessary, the authors also relied on their respective experiences gained over the years in contributing to the debate and formulation of low carbon development both at the national and international levels. The desktop study helped in understanding, the existing institutional structures and the roles they play in the coordination and implementation of low carbon development strategies in Ghana. The desktop study involved extensive review literature from both national and international sources.

At the national level, existing reports on institutional governance for the coordination and implementation of climate change in Ghana were reviewed. The following documents were consulted: existing development frameworks, strategies, policies and reports that have bearing on low development, development planning and public expenditure and budgeting. The documents were obtained from Ministries, Departments and Agencies (MDAs). The literature review of international sources information contributed to framing the current-state-of knowledge of the low carbon development and to understand the role of institutions in driving low carbon development. The interviews included the collection of information from the various sources in organizations through personal communication, email exchanges and telephones. In all, 25 organisations were interviewed. The organisations were public offices, universities and some NGOs.

3. Ghana's national development agenda and evolution of 'climate change friendliness' in the agenda

This section reviews the evolution of the country's current national development plan. It then examines the linkages to climate change mitigation, institutions and coordination of activities within that framework. It subsequently highlights potential LCD institutional arrangements for Ghana with emphasis on mitigation aspects which is the focus of the paper (rather than adaptation). This is based on the observations made during the desktop reviews and the interviews.

3.1. Brief background information how Ghana's current National Development Agenda evolved

The 1992 Constitution of Ghana (the Directive Principles of State Policy) is among the early directives that somehow covered (indirectly though) issues pertaining to environmental and institutional development. The specific article in this directive that indirectly touches on the environment and subsequently climate change is article 36 (section 9) which indicates that the State shall take appropriate measures needed to protect and safeguard the national environment for posterity; and shall seek co-operation with other states and bodies for purposes of protecting the wider international environment for mankind.

This led to the formation of the National Development Planning Commission (NDPC) which is the constitutional body created by the National Development Planning Commission Act, 1994 (Act 479) with the purpose of advising the President in the area. The NDPC also coordinates and regulates the decentralized national development planning system in accordance with the National Development Planning System Act, 1994 (Act 480). Since its establishment, the NDPC has been formulating development plans for the nation. Additional information on the NDPC will be discussed

later in this study under the institutional arrangements for climate change mitigation and low carbon development. The government in 1996 re-oriented all development policies around economic and social development, more specifically poverty reduction. This culminated in the first Medium Term Development Plan (MTDP) which was implemented from 1996 to 2000 (and was part of the then Ghana's Vision 2020 strategy).

In year 2000, Ghana's Vision 2020 was discontinued due to macroeconomic imbalances and substituted by the WB/IMF sponsored (in year 2000–2002) *Interim Poverty Reduction Strategy Paper (IPRSP)*. Then from year 2003–2005, the nation instituted the *Poverty Reduction Strategy I (GPRS I)*, which was later developed into *Growth Poverty Reduction Strategy Paper II (GPRS II)* from 2006–2009 and presently the GSGDA [2].

With the following core goals, the current national development blueprint which is the GSGDA [2] aims to [8]:

- ensuring and sustaining macroeconomic stability
- making Ghana's private sector more competitive
- improving the rate at which the agricultural and natural resource sectors are modernised in sustainable manner
- improving developing Ghana's fossil fuel sector
- human settlements and infrastructural developments
- job creation, developing human capacity and overall productivity of the economy
- accountability in governance and transparency

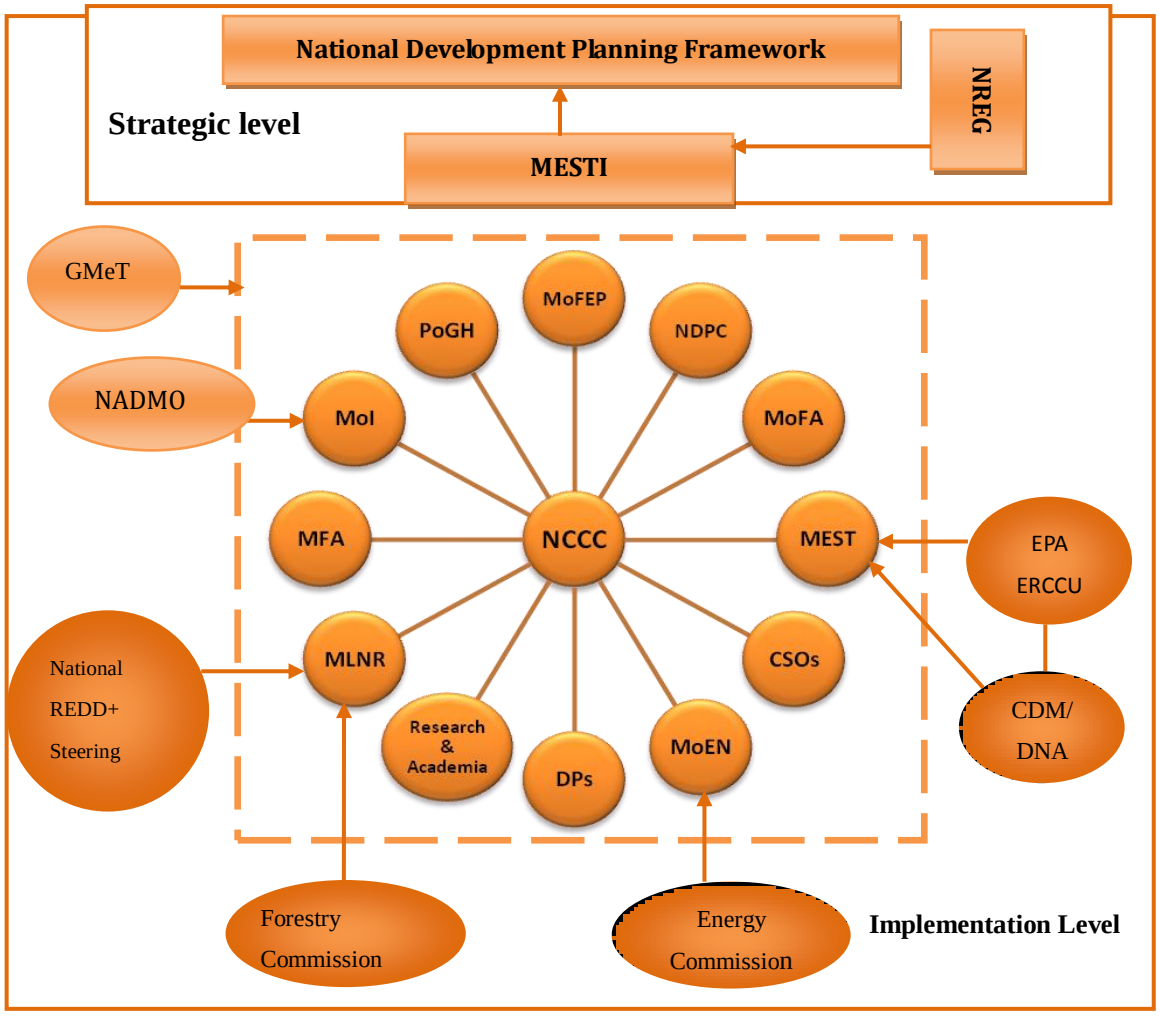
This current national development blueprint indicates clearly that climate change will have adverse repercussions on all sectors of the economy. In line with this understanding, Ghana Shared Growth and Development Agenda (GSGDA) propose the mainstreaming climate change activities into all development programmes and projects. This enjoins every public institutions i.e. MDAs to do same in their policy development and implementation.

3.2. Institutions involved in climate change mitigation planning and coordination of activities

The Ministry of Environment, Science, Technology and Innovation (MESTI) is the lead institution for climate change. It is the host organization for the National Climate Change Committee (NCCC) and as well it is the focal government institution for UNFCCC activities in Ghana. The NCCC is made up of representatives from relevant ministries, universities, research institutions, the private sector and non-governmental organizations (NGOs) (Figure 1). The MESTI together with the NCCC Secretariat and the Environment Protection Agency (EPA) helps coordinate all the climate change activities in the country.

Specifically, the NCCC has membership from Ministry of Environment, Science, Technology and Innovation (MESTI), Ministry of Finance and Economic Planning (MoFEP), National Development Planning Committee (NDPC), Ministry of Lands and Natural Resources (MLNR), Ministry of Food and Agriculture (MoFA), Ministry of Energy (MoEn), Energy Commission (EC), Ministry of Health (MoH) Environmental Protection Agency (EPA), Ministry of Foreign Affairs (MFA): Parliament of Ghana (PoGH),: Ministry of the Interior (MoI), Ministry of Energy and

Petroleum and Ministry of Power (the two latter ministries previously operated jointly as the Ministry of Energy), Ghana Meteorological Agency (GMeT), Forestry Commission (FC), Private Sector—Ecobank, Ghana, Research and Academia—ISSER, University of Ghana, Civil Society Organizations (CSOs) including Friends Of the Earth and Conservation International, Conservation Alliance, ENAPT Centre, Abantu for Development and Development Partners represented by the Netherlands Embassy.



Source: [4] with modifications

Figure 1. Institutional arrangement for coordinating climate change activities in Ghana.

Acronyms:

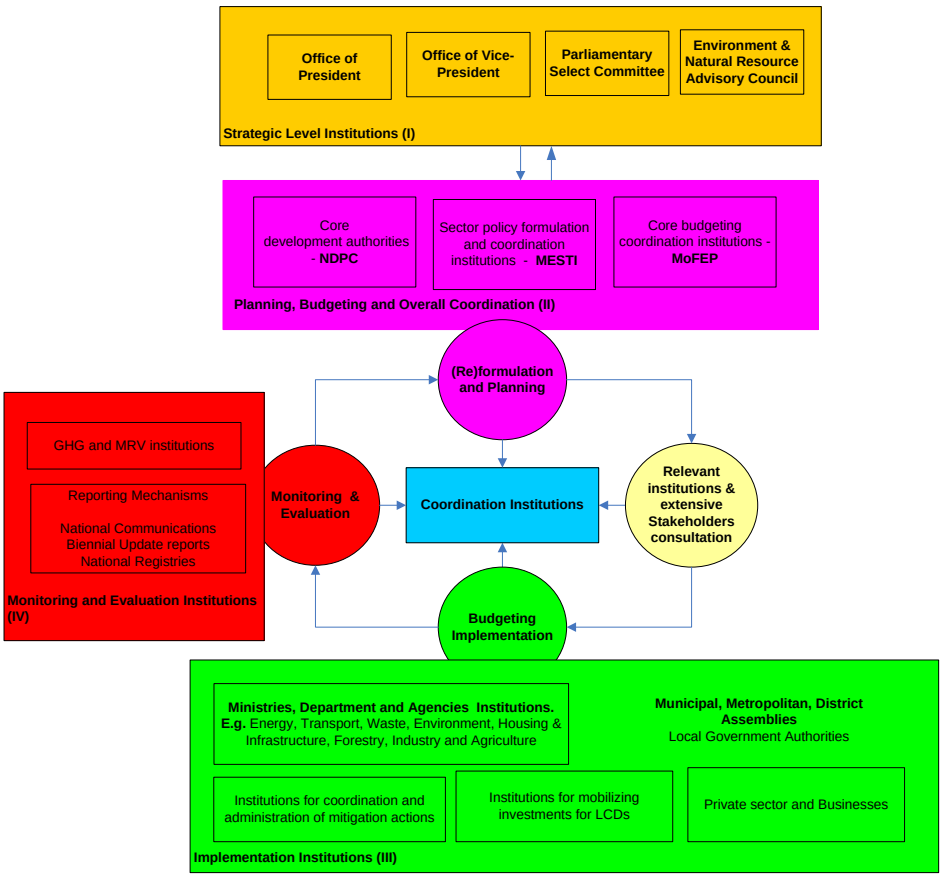
***NCCC**: National Climate Change Committee, **MoFeP**: Ministry of Finance and Economic Planning, **NDPC**: National Development Planning Commission, **MLNR**: Ministry of Lands and Natural Resources, **MoFA**: Ministry of Agriculture, **MESTI**: Ministry of Environment, Science, Technology and Innovation, **CSOs**: Civil Society Organizations; **CCU**: Climate Change Unit, **EECCU**: Energy Efficiency and Climate Change Unit, **CDM/DNA**: Clean Development Mechanism/Designated National Authority, **MoEn:** Ministry of Energy, **DPs**: Donor Partners, **MFA**: Ministry of Foreign Affairs, **PoGH**: Parliament of Ghana, **NREAG**: Natural Resource and Environment Advisory Council, **GMeT**: Ghana Meteorological Agency, **MoT**: Ministry of Transport, **CUT**: Centre of Urban Transport*

Note: The institutional arrangement in Figure 1 does not represent the hierarchical flow of functions and roles within the national development planning process. It rather provides graphical representation of the various institutions and their interrelationship to national climate change activities.

The Natural Resources and Environmental Governance (NREG) programme is a sector budget support and strategic coordination mechanism involving the sectors (environment, forestry and mining) and the donor partners. The NREG Advisory Council has the Vice-President Office as its Chairperson and it is at this point that the highest possible political level climate change and environment issues are strategically coordinated.

3.3. Mapping out LCD institutional arrangements for Ghana

Institutional arrangements have been identified as one of the major enabling factors for low carbon planning cycle and LCD implementation [9,10]. In Ghana, a number of public institutions perform different functions within the mainstreaming framework of climate change and national development. Categorization of the various planning institutions according to their roles in low carbon planning and their interrelationships has been summarized in Figure 2.



Source: *Authors*

Figure 2. Categorization of low carbon institutional functions and inter-relationships in Ghana.

In Ghana, four (4) broad categorizations of institutions potentially exist for national low carbon development effort at the various planning levels. These include (i) strategic level institutions that set the overarching LCD vision and policy (ii) core planning, budgeting and coordinating institutions (iii) implementation institutions, organizations/authorities (iv) institutions for monitoring and evaluation (M&E). The functions of these institutions are largely defined by their legal and operational mandates as enshrined in the national statues from which they were established. There is, however, the need for some 'fine-tuning' to the existing roles of these institutions so they can effectively address the challenges associated with mainstreaming the nascent LCD component into exiting national development process.

The section below highlights the institutions involved in the LCD planning in Ghana that have been categorized in Figure 2 and their interconnectedness.

3.3.1. Strategic level institutions

A critical factor for success in LCD in developing countries is the ability to receive the 'buy-in' at the highest possible political level. In Ghana, the decision to commit to low carbon development trajectory stems from the government economic development vision to move the country from low middle income country to a fully-fledged middle income state by the year 2020. The recognition of low carbon development in the government's economic transformation agenda reinforces the importance it attaches to that development pathway thereby providing a certain level of authority as basis for 'buy in' from the ministries, department, agencies (MDAs). The strategic level institutions and bodies for LCD planning in Ghana comprises of:

i. the office of the President,

ii. the office of the Vice President,

iii. Parliament of Ghana as well as the

iv. the Natural Resources and Environmental Governance (NREG) programme

These institutions and bodies define the broad development agenda for Ghana including LCD plans. They also have the mandate to set development priorities and pursue it through the allocation of national resources. Typical of any democratic country, the roles of the office of the President, the Vice President and the Parliament in helping to set low carbon friendly development agenda seem pretty obvious as in any democratic country. The NREG Advisory Council has the Vice-President Office as its chairperson and it is at this level that the highest possible political level climate change agenda including low carbon development plans are strategically coordinated. The NREG however, is a sector budget support and strategic coordination mechanism which seek to bring reforms in the real sectors of the economy.

3.3.2. Core planning and budgeting coordination institutions

The planning, budgeting and overall coordination of LCD is predominantly undertaken by three institutions and bodies namely, the National Development Planning Commission (NDPC)**,** Ministry of Finance and Economic Planning (MoFEP) and Ministry of Environment, Science, Technology and Innovation (MESTI).

3.3.2.1. National development planning commission (NDPC)

The NDPC is the central development planning and coordination authority in Ghana and also facilitates the preparation of the medium term development plans through cross-sector planning groups. The NDPC was created by Act 479 [11] to advise the President on national development planning policy and strategy. It also coordinates and regulates the decentralized national development planning system. The role of the NDPC is particularly essential in the formulation and integration of LCD into national development especially ensuring that LCD is in tandem with national development priorities and plans.

3.3.2.2. Ministry of finance and economic planning (MoFEP)

The Ministry of Finance and Economic Planning plays central fiduciary management role in national development planning. Their fiduciary functions relates to budget coordination and fiscal policy setting within the economic development framework. The MOFEP has a convening role for planning and budgeting [12]. Insofar as, the LCD anchors on the medium term national development priorities, the MDAs and MMDAs receive directives by the MoFEP to make necessary budgeting allocations. The directives are usually issued through the budget guidelines to all MDAs and MMDAs.

Another layer of the public financial administration and management system is the public hearing tools. The tools help the MoFEP to set budget priorities for the year as the basis for allocating public resources for the implementation of the medium development plans. In other words, the implementation of LCD hinges significantly on the availability of public financial resources from MoFEP. Apart from the fact that MOFEP have financial administration mandate, they also have central management oversight for the mobilization of donor funds. The real sector desk at MOFEP has the responsibility of identifying sources for mobilizing climate finances. The MOFEP also have the capacity for leveraging private capital for development finance including LCD through its fiscal incentives tools. The Ministry has a functional fiduciary structure in place as part of their public financial administration responsibility and therefore their potential role in the setting up of domestic MRV will be essential.

3.3.2.3. Ministry of environment, science, technology and innovation (MESTI)

In Ghana, MESTI plays the leading role in the overall coordination of the implementation of the national climate change and low carbon development activities. The MESTI also host the National Climate Change Committee (NCCC) which in part helps the ministry in facilitating the process of seamlessly fitting together the climate change and low carbon agenda into the national development process. The NCCC is a multi-stakeholder committee of Ministries, Department and Agencies (MDAs), Donors, Parliament of Ghana, CSOs, research institutions and representatives of the private sector.

3.3.3. Implementation institutions

3.3.3.1. Environmental protection agency and other institutions

In any LCD planning process, it is necessary to define and assign roles of MDAs that would be given the implementation responsibility. The EPA is responsible for coordinating the implementation of the technical component of climate change activities including LCD. It does so through its energy resources and climate change unit and draw its mandate from the Act 490. The unit serves as the technical clearinghouse for LCD as well as the fulcrum for international cooperation programmes. The climate change unit is the focal point for UNFCCC, the Intergovernmental Panel for Climate Change (IPCC), and playing the leading role for the preparation of national communication [3] to the UNFCCC. Within the unit, the programme on mitigation, GHG and reporting have the responsibility for the national greenhouse gas inventory as well as the biennial update report. The EPA is therefore at the center of domestic MRV activities and coordinate national institutions working in this area.

The MRV functions of LCD include monitoring, registry and reporting responsibilities. The monitoring aspects relate to the national system for GHG inventory. The national system for the GHG defines institutional arrangement, roles and governance mechanism for conducting the national GHG inventory. The GHG inventory tasks have been decentralized among five sector institutions with EPA performing coordinating role. The EPA also hosts a central database infrastructure which serves as national registry for LCD inventions. Reporting of LCD impacts is at two levels, national and international [3]. At the national level, the sector agencies are expected to report on the impacts of their LCD interventions on both GHG and the overall sector development whereas EPA focuses on putting all the sector impact reports together into biennial update report and national communication to the international community. The ministries of energy, forestry, transport, local government and their agencies implement LCD actions in the respective sectors.

3.3.3.2. Energy sector institutions

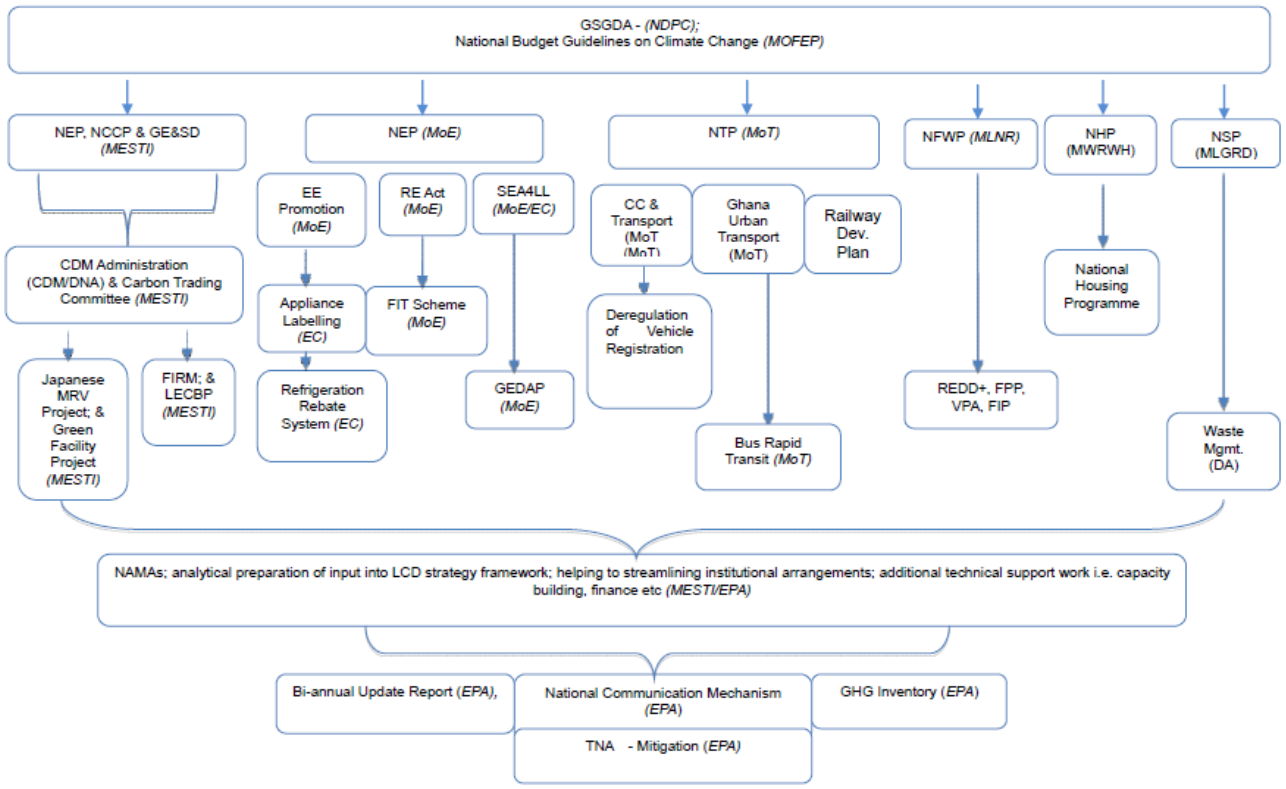
The energy sector is one with potential to attract private investment in the low carbon areas. The low carbon investment spectrum ranges from energy resource management, energy transformation/transmission and demand side activities. The Ministry of Energy and Petroleum has the mandate for policy formulation and coordination for the sector, the implementation thereof is however done by different institutions. The energy sector is largely grouped into electricity and petroleum sub-sectors institutions. At the policy level, the Ministry of Energy and Petroleum provides long-term vision for the sector through the national energy policy. What is stipulated (or get amended) in Ghana's energy policy could be very essential in helping to advance national LCD effort. The electricity sub-sector institutions are mandated to provide energy services [14].

Public electricity generation, transmission and bulk distribution services are done by Volta River Authority, GRiDco and Electricity Company respectively. A number of independent power producers complement the generation activities. Tariff regulation is done by the Energy Commission and Public Utility and Regulatory Commission respectively. The Energy Commission also responsible for the promotion of energy efficiency and improvement practices. The petroleum sub-sector is regulated by the Petroleum Commission. The Ghana National Petroleum Commission and the Jubilee partners are responsible for the upstream activities in the petroleum sub-sector while

Ghana Gas Company is mandated to process the national gas and makes it available to the Ghanaian market. These institutions could therefore play catalytic roles in ensuring that LCD priorities are factored into their respective strategies.

4. Selected cases of major low carbon initiatives in Ghana (past, present and planned)

Most of the LCD activities in Ghana seem to predominantly centre on energy and transportation sectors. Recently, however there has been growing interest in land use (agriculture and forestry), specifically in REDD^{+} related issues as well as waste to energy options (Figure 3). Ghana has already submitted its positive-list of 55 NAMAs to the UNFCCC in response to the Copenhagen Agreement. The list contains diverse mitigation actions from selected sectors when implemented will contribute to aligning to low carbon trajectory. Because the NAMAs are diverse it is important they are prioritized. Ghana has therefore prioritized its NAMAs from fifty five (55) to twelve (12) and further to five (5).



Source: Authors

Figure 3. Schematic summary of key policies, projects, programmes that relates to LCD undertaken by the Ghanaian government.

Note: In order to distinguish acronym of institutions from programmes, policies and projects, the former has been *italicized.*

Acronyms:

NEP: National Environment Policy, **NCCP**: National Climate Change Policy, **GE&SD**: Green Economy and Sustainable Development, **CDM**: Clean Development Mechanism, **DNA**: Designated National Authority, **FIRM**: Facilitating Implementation and Readiness for Mitigation, **LECBP**: Low Emission Capacity Building Programme, **NAMA**: Nationally Appropriate Mitigation Action, **NEP**: National Energy Programme, **EE**: Energy Efficiency, **RE**: Renewable Energy, **FIT**: Feed-in-Tariff, **SE_4All**: Sustainable Energy for All, **GEDAP**: Ghana Energy Development and Access Project, **NTP**: National Transport Policy, **CC**: Climate Change, **NFWP**: National Forest and Wildlife Policy, **REDD$^+$**: Reducing Emissions from Deforestation and Forest Degradation (plus), **FPP**: Forest Partnership Programme, **VPA**: Voluntary Partnership Agreement, **FIP**: Forest Investment Programme, NHP: National Housing Policy, NSP: National Sanitation Policy, **MESTI**: Ministry of Environment, Science, Technology and Innovation, EC: Energy Commission, **MoT**: Ministry of Transport, **MLNR**: Ministry of Lands and Natural Resources, **DA**: District Assemblies.

Specifically the five highly prioritized NAMAs include:

1) Developing and improving facilities for public transport system; (2) Promoting the use of LPG; (3) Promoting the use of energy efficient cooking devices; (4) Switching to natural gas (combined cycle) and (5) Establishment of sustainable agro-forestry for woodlots plantations and charcoal production.

Among the six criterion used for the prioritization, "alignment of NAMAs to sector development plans" was key. Each institution contributed to the choice of prioritized based on their plans.

Detailed information on Ghana's 55 NAMAs can be found in EPA (2011) [4]. However, most of the country's proposed 55 NAMAs are in areas indicated in Figure 3, which includes renewable energy electrification, energy efficiency, developing and improving facilities for public transport system, promoting the use of Liquefied Petroleum Gas (LPG), promoting the use of energy efficient cooking devices, switching to natural gas (combined cycle), implementing REDD+, mechanism, promoting Small Afforestation/reforestation activities at the community level, promoting sustainable forest management, enhancing the rehabilitation of degraded forest lands and establishing sustainably produced commercial woodlot plantations. The section below describes some of the major initiatives. The section is supplemented by Figure 3 in providing a schematic overview of major government policies, programmes and projects in the area

4.1. Energy policies and programmes

4.1.1. Renewable energy policies and programmes

Since the 1990's, Ghana has implemented a number of initiatives that supports renewable and clean energy. This includes the *Renewable energy-based electricity for rural, social and economic development in Ghana (RESPRO)* which was funded by the Global Environment Facility (GEF). Additionally, the country has passed its renewable energy law. The law has a feed-in tariff component and require consumers with high electricity demand to purchase a minimum threshold of renewable energy. The government of Ghana and the GEF have been discussing on options for financing the feed-in premium through the project *'Integration of renewable energy sources into the national energy grid mix'* [15]. The Energy Commission is the lead government agency in Ghana for renewable energy initiatives. The government is presently in discussions with the private sector in

order to effectively encourage their participation especially regarding the financial sector in the scheme. Aiming to achieve wider access to energy services via off-grid renewable energy options, the government initiated the *Ghana Energy Development and Access Project (GEDAP)*. However this requires new and innovative financing models as well as private sector involvement. Additionally, the development and use of tools such as geographic information system (GIS) for renewable energy planning applications is being undertaken with the help of the Renewable Energy and Energy Efficiency Partnership (REEEP).

4.2. Energy efficiency

4.2.1. Compact-fluorescent lamp (CFL) bulbs

The Ministry of Energy, the Energy Commission (EC) and Energy Foundation are the key national institutions that are responsible for energy efficiency activities and have implemented a number of projects and programmes. In terms of regulations, the government passed the Energy Efficiency Standards and Labelling Regulations (LI 1815) in year 2005. Then in 2008, a complimentary regulation, legislative instrument 1932, banning the manufacture, sale or importation of incandescent bulbs (also used refrigeration and used air conditioning appliances) was also passed. In support of LI 1932, Ghana undertook a 15 million USD nationwide activity of providing free energy efficient bulbs as well as installation services. This led to the use of more energy efficient lighting options such as compact fluorescent (CFL) and LED bulbs compared to incandescent bulbs. The result is significant energy savings that otherwise would have been provided from 200–240 MW new power plant is achieved. Additionally, approximately 100,000 tCO_2 eq. is mitigated each year.

4.2.2. Refrigerators

Similar to lighting appliances, the government of Ghana has put in place a number of regulations to promote energy efficiency in refrigeration and freezing appliances including: LI 1932 (2008) as mentioned earlier; Energy Efficiency Standards And Labelling (Household Refrigerating Appliances) Regulations, (LI 1958) passed in 2009 and Energy Efficiency Standards And Labelling (Household Refrigerating Appliances) (Amendment) Regulations, (LI 1970) in year 2010 [16].

The government of Ghana is currently embarking on a 5.7 million USD programme entitled *'Promotion of Appliance Energy Efficiency and Transformation of the Refrigerating Appliances Market in Ghana'.* The ultimate aim of this programme is to get Ghanaians to return their old refrigerators and receive a rebate (in cash or coupon) that could be used toward the purchase of a new fridge.

4.3. Energy projects

4.3.1. Renewable energy projects by VRA

The Volta River Authority (VRA) is the main electricity generation agency in the country. Activities are quite advanced by the company to produce from wind and solar sources 100 MW electricity with an estimated cost of approximately $40 million (US). Based on the results from the

resource feasibility analysis, the solar power plants will be situated in the northern parts of the country while the wind turbines will be located along the coastal areas due to their favorable wind speeds.

4.3.1.1. Kpone thermal power plant (KTPP)

This is a government of Ghana (GoG/VRA) 230 MW Simple Cycle Thermal Power Project, which is being developed. The plant consists of 115 MW capacity each of 2 Alstom units. The gas turbines are already in the country at the Kpone Site, near Tema. VRA is currently mobilizing funds for the project with an expectant completion and commissioned by 2015.

4.3.1.2. Takoradi 2 (T2) thermal power project expansion

This is undertaken by a company that is owned by both the VRA and TAQA Energy from Abu Dhabi, United Arab Emirates). The project seeks to expand by an additional 110 MW, the 220 MW Takoradi (T2) plant to a combined cycle power system from its initial simple cycle power plant. The project is expected to be completed and commissioned in 2015.

4.3.1.3. Takoradi (T3) combined cycle thermal power project

This is a government of Ghana (GoG/VRA) funded 132 MW Combined Cycle Thermal Power Project currently under construction and strategically situated near existing VRA Thermal Power Plants at Takoradi. This power generation facility consist of four (4) UGT 2500 Gas Turbines, four (4) Once Through Steam Generators (OTSGs) and a Steam Turbine [17].

4.3.1.4. Bui hydro plant

This is a hydropower project currently under construction and is expected to be in full operation by December 2013. The project is located on the Black Volta River at Bui. This power plant when completed is expected to add 400 MW of installed generation capacity to the existing generation resources. The plant consists of three turbines of 133 MW capacity each. Civil works on the hydro power plant has mainly been completed. Phase 1 of the power plant is currently in operation under the Bui Power Authority (BPA). Total cost of the project is $622 million (USD) with the government of Ghana providing a tenth of the amount and the rest being finance by China.

4.3.2. Sunon-Asogli power plant

This is an independent power producer (IPP) company that presently generated 200 MW of electricity. It is owned by Shenzhan Energy Group Limited (60% shares) and China Africa Development Fund (40% shares). The company plans to generate an additional power of 360 MW in the second phase which will come from a natural gas combined cycle operation at an investment cost of US $360 million. It plans to produce generated capacity of 1000 megawatts in the near to medium term.

4.3.3. Asogli limited wind power projects

The Sunon-Asogli Power Ltd plans to set up two wind turbines to generate power in the Greater Accra and Volta Regions at Ada and Angola respectively. The two identified locations seem to possess some of the most suitable wind speeds nationally [16].

4.4. Transport

One of the priority LCD activities in Ghana is the Bus Rapid Transit which is a radial arterial urban transport route running to the central business district of Accra from its outskirts [18]. An estimated 12,000 peak hour passenger journeys each direction is expected to be achieved [19]. During such peak periods bus frequencies of 120 buses/hour have been estimated [19]. In addition to these projects, rail transport services from Tema to Accra and from Nsawam to Accra are being planned. Additionally, is rehabilitation work on the Kwasimintin to Takoradi rail lines.

4.5. Agriculture and forestry sectors

Based on state of the art satellite analyses, the government of Ghana together with researchers and relevant private sectors is developing a nationwide carbon stocks with the potential of providing robust data and information for REDD+ and related MRV efforts nationally.

5. Major observations from the institutional analysis

Development structures are channels for delivering public services to all levels of society. The structures are made up of the following (a) institutions, (b) their set of roles defined by statutory instruments, (c) mechanisms for collaboration and coordination. The extent of the interactions between the elements of the development structures influences its efficiency and the ability to meet changing demands. Mainstreaming LCDs into the existing development structures will be beneficial; however most of the institutions have challenges in understanding how the nuances of LCDs will play out on their set priorities. So far, the LCDs space has been dominated by the environment sector institutions although other sector ministries are emerging. This presents a major difficulty for greater assimilation of LCDs for most institutions. The incentive to buy-in into LCDs has not been demonstrable enough for the institutions. By more awareness, the institutions become convinced and willing to commit resources to support it. One observed characteristics of the involvement of the institutions in LCDs is the fact that most get funding support from external sources. Although that in itself is a positive sign for cooperation, such activities do not necessarily culminate in the anticipated desired changes.

Another observation that has challenged the greater buy-in of institutions in LCDs is the tendency to “projectised” international LCDs assistance. Most of the public institutions see LCDs initiatives as “projects” that has beginnings and endings. Without providing the larger perspectives, putting the LCDs agenda thinking into silos will have the likelihood of losing the need for connectedness with other development initiatives. The consequences are that, LCDs agenda does not get the needed visibility across ministries, departments and agencies. Most of the ministries, department and agencies do not necessarily delineate funding to support LCDs because it is simply not their priority. Therefore

their assimilative capacity to LCDs resources must be targeted in a way that it adds value to the overall competence, orientation. Keeping the business-as-usual institutional arrangement is not only likely to be counter-productive to mainstreaming LCDs but also challenging to trust-building principles such as result-oriented, transparent and accountable. Particularly in the current climate-regime where emission reduction claims are tied to support, (MRV for support), having access to LCDs funding would require high calibre of institutions that have the right people with skills and processes to be competitive.

Mainstreaming of LCDs is important and supported by well-coordinated institutions which have the necessary capacities and skills to deliver them. In order for the institutions in Ghana to buy into the LCDs agenda, it is important that LCDs get into the main national medium term development framework upon which the various translate into sector priorities. This is surest means of ensuring greater visibility in government and for private sector to come in.

6. Key challenges and analysis

Some of the major hurdles that could help improve low carbon development in Ghana when remedied includes institutional related barriers, inadequate human capacity, regulatory challenges, financial issues, data inventory and quality, appropriation of funds, concerted multi-disciplinary effort and extensive consultation with all stakeholders (and local communities).

6.1. Institutional related barriers

As indicated above, institutions are challenged with myriad of *intra* and *inter* –institutional barriers that constrain them considerably from functioning effectively within LCD framework. Specific institutional related barriers (intra and inter) relate to the following aspects: ineffective coordination, capacity and skills, lack of visibility of LCD and inadequate or clear institutional mandate and capacity and skills (also described below since it is an issue that cuts across all segments of the low carbon development process).

6.2. Inadequate human capacity

Though there exist considerable human capacity locally there is still the need to improve and achieve a very strong knowledge base at all the different facets and processes of low carbon development. Specific areas that requires enhanced capacity building development includes data analysis, interpretation, modelling, developing baselines, monitoring, reporting and verification (MRV) especially in REDD+/forest sector carbon accounting. Over the years the country had to build some capacity in CDM, including project design documents (PDDs) for a number of projects as well as having registered projects such as the Zoom Lion Waste to Energy. However, improving Ghana's human capacity in NAMAs and low carbon development could be beneficial to the state. The UNEP DTU Partnership's NAMAcademy seem to be a potential option to provide the needed training to government officials in formulating LCD policies as well as in NAMAs [20].

6.3. Regulatory related barriers

Government regulations are mechanisms that are designed to facilitate orderly penetration of development ideas, technology and investment without compromising quality and standards. However, in most cases the implementation of the regulation become burdensome and counterproductive to the course it was originally intended for. For example in 1999, in an attempt to promote wider diffusion of cleaner energy technologies, the government removed the import duties on PV panels and balance of systems and importers had to only pay for the value added tax (VAT) which was 5% at the time. However, the policy was later amended to render the balance of systems (BOS) dutiable. This was because the original policy got abused by people who saw a gap in it and decided to exploit the shortcoming in the policy to import BOS into the country tax free even though they sold the BOS (such as the batteries and pumps) on the regular market and not for use with a solar/PV systems.

Another example is the situation whereby potential investors are confronted with plethora of processes and procedures by at different institutions. Regulatory related barriers exert a negative impact regarding attractiveness to investors as it poses an additional layer of hurdle that investors need to deal with especially relating to high upfront transaction cost. The combined effects or repercussions is possibly evident in the low LCD investments nationally (similar to other parts of Africa) in comparison to other continents. In order to address regulatory related barriers (either institutional, frontloaded processes or behavioral) would require greater orientation towards improved efficiency, coordination and above all aligned with the public sector reforms to ensure long term positive changes. This approach will progressively reduce the risk and possibly incentivize investors.

6.4. Financial cost

The high financial and transaction cost of LCD investments is a major barrier in Ghana. The costs related to the LCD business development are not only capital costs but also those related to transfer and access to technologies and associated information (performance and vendors). Sometimes the upfront costs in engaging in LCD activities tend to so high that it discourages investors. Additionally, investors tend to shy away from markets that are not competitive due to capital and transactional risk. The involvement and use of government guarantee systems in public private partnership could help provide the needed financial safety net and certainly this seem to be one sure option to attract investments. With respect to the uptake of transferable technologies and its associated cost, the use of market indicators and access to information is useful. However, the bigger challenge is the way local banks in Ghana seem not to fully get engaged in the mobilization of funds for LCD activities. They generally consider LCD activities as risky portfolios which require significant investments but also one that the returns seem to occur in the longer term (and not near term).

6.5. Data inventory and quality

In order to develop and implement effective LCD framework, it would also require having in place robust national system for conducting GHG inventories. The national system will not only help to produce the inventory on time, it also sets out mechanism for collecting data on continuous basis. In Ghana, data for inventory is challenged in a number of fronts. In most cases, (a) there are frequent gaps in the data time series, (b) missing or non-existing data, (c) data not in the format that could be used in the inventory and above all (d) data on same activities from different national sources seem incomparable. The combined effect is that, it becomes difficult to set up MRV system that would significantly rely on national data sources without making up for this limitation by complementing it with international data sources. The result is that the overall accuracy, reliability and transparency of the inventory estimates become difficult to defend to the extent that it poses serious accounting challenge to any successful LCD programme. The on-going national effort to reform the national system for GHG would ultimately strengthen the way national inventories are conducted. The ongoing reforms seek to address issues relating to: data management including archiving systems, institutional arrangement and decentralization and training and capacity retention.

6.6. Allocation of funds for LCD activities (since LCD is recognized as the way forward for national development in Ghana)

Information on direct funding sources for LCD activities in Ghana generally need further investigation and analysis. The current sources for funds are mainly; (a) donor aids which come in different forms ranging from technical assistance, budget support, grant and in some case loans and (b) national budget. The donor funds support different aspects of LCD activities. Substantial amounts go into support for 'enabling activities' (such as reporting, setting up MRV systems, GHG inventories and capacity building) and "capital investments" in a form of loans (concessional or any other arrangement). For example, Ghana is using considerable amount of its $3 billion (USD) Chinese loan to develop its gas infrastructure plant. The plant is expected to process gas for use in thermal electricity generation plants because of its cost effectiveness. The spin-off effect of having 50% of the total installed thermal generation capacity running on natural gas would result in considerable reduction of Ghana's carbon intensity within the electricity generation sub-sector in Ghana. Ghana's national budget is another source funding for LCD activities. Although some levels of funding exist in the national budget, generally for investing in infrastructure services in sustainable energy, transport and waste, it has not been clearly delineated and ring-fenced enough to cover the full cost of priority LCD projects. Appropriations for LCD activities have also been generally inadequate. Governments would probably have to find innovative means for mobilising more financial resources from private sector to support its effort.

6.7. Lack of coordination regarding the various multi-disciplinary research effort

Multi-disciplinary research is indispensable for evidence-based LCD policy making. However, research efforts in this area had not been particularly coordinated in Ghana. Different research groups in the country undertake number studies for reasons sometime other than what would be

specifically useful for LCD. The linkages between LCD and related policy research need to be strengthened.

6.8. Extensive consultation with all stakeholders (and local communities)

Consultation with stakeholder is a very useful aspect of LCD. It helps ensure that concerns of stakeholders are heard and adequately addressed. The mechanisms that would be put in place to facilitate and manage stakeholder consultation would be a potential barrier especially in terms of cost and time management. The cost of not adequately consulting stakeholders would be a grave risk to the success of implementing LCD interventions. Therefore, it is important to recognise the need to have good balance between different consultation mechanisms and how it would result in positive spin-off effects especially with regards to time, cost and overall sustainability of the LCD activity.

7. Possible ways forward for developing LCD in Ghana

The first would be to put in place, processes toward the formulation and development of an overall comprehensive LCD strategy. However such endeavor rather requires significant time, effort, resources and extensive stakeholders' consultations [15]. An immediate term, option might be for the country to develop the framework for LCD strategy. This option seem already underway by the government of Ghana with technical and institutional capacity building support from UNEP's Facilitating Implementation and Readiness for Mitigation (FIRM) project. The FIRM project in addition to helping Ghana with developing a LCD strategy framework also aims to identify and remediate non-financial barriers associated with NAMA development. The need to improve data availability and accuracy is very essential for Ghana LCD strategy framework development as well as the LCD strategy formulation and this could possibly be prioritized as requiring further study and investment support. Additionally, is the prioritization of modelling tools and building capacity at local levels with regards to the use of the tools and interpretations of findings. It might be recommendable for Ghana to establish sector and/or economy wide baseline and reference scenarios as initial steps for possible scale-up to the national level LCD strategy [14,15]. The GHG mitigation potential of Ghana's 55 NAMAs could possibly be factored into the overall LCD strategy as components of the complementary pieces of puzzles.

There is the need to put in place governance mechanism that especially ensures that local level priorities get addressed in LCD strategy [16]. Extensive stakeholders consultations at all levels of society will go a long way to ensure transparency and ownership in LCD activities at the grass root level and serves as a good catalyst for establishing effective governance mechanism. Additionally, greater dissemination and availability of information, public education and communication on LCD is essential. This point has been highlighted in the country's medium term development agenda document i.e. GSGDA but there however remains the need to formulate LCD strategy and mainstream it into national development plans with increased awareness created through extensive communication.

The role of research cannot be over-emphasized in developing LCD in Ghana. Although climate change research is usually a long term endeavor that requires, coordinated activity and cross disciplinary effort, however, it is common to find in Ghana a number of short term, project based research that are uncoordinated. A dedicated research institution such as the proposed Climate

Change Research Centre is a step in the right direction to possibly bridge the data, knowledge and research gaps as well as coordinating the various climate change activities by the universities, R&D institutes, ministries, departments and agencies. Finance for implementing LCD activities is an expensive undertaking and international donor support coupled with local funding is essential. The apparent international recognition of the Ghana's credible Public Financial Management system and leadership might possibly play significant positive roles toward accessing external funding. Finally (but not the least), since LCD like any policy development activity is complicated, a sustained strong political will by Ghana toward LCD is what will be needed in order to achieve its desired low carbon growth trajectory in the long term.

To further improve institutional cooperation and coordination within the context of LCD and development priorities, middle to senior level officials from various relevant government and public departments as well as academia, private sector, NGO and civil societies meet at least on bimonthly basis to work closely together in developing LCD strategy framework for Ghana through UNEP sponsored 'Facilitating Implementation and Readiness for Mitigation' Project. This initiative is being led at the local level by the Ministry of Environment, Science, Technology and Innovation.

8. Discussions on Ghana's LCD activities for potential lessons to other developing countries

The LCD planning cycle requires carefully sequenced approaches including (a) formulation of goals, (b) efficient institutional framework, (c) prioritization of polices and measures, (d) implementation and (e) monitoring. This sequence of LCD planning steps must be anchored on effective coordination, leadership and extensive stakeholder consultation. Although Ghana's national circumstance is unique in many respects, there are fundamental commonalities among LCD planning elements outlined by previous studies [18,21,22]. Undertaking LCD in Ghana and other developing countries requires that institutional structures and processes are first in place to drive the LCD planning process. It is important to note that developing countries that are planning to engage in LCD may not necessary have to put in place brand new institutional structures as several countries already have existing structures that coordinate climate change activities.

Lutken *et al*. 2011 [23] further indicated that, such structures should logically be the starting point for LCD activities but it is important that ministries responsible for national development planning are closely integrated to ensure that LCD activities are rooted in the regular national processes and not running as a parallel climate change exercise. The lesson from Ghana is that a lot less cost would be incurred if developing countries consider embedding LCD planning into existing public institutional structures although some tweaking to conventional institutional roles may be necessary. What is rather critical for developing countries would be the need to work towards progressive improvements in the overall competitiveness of public institutions involved in LCD activities. Equally important is that the institutions should have clear roles and responsibilities as that would not only help prevent institutional conflicts but also facilitate better collaborations.

9. Conclusion

Ghana has made progress in establishing institutions, put in place policies, strategies, coordinating mechanisms and other relevant processes to facilitate the implementation of climate change mitigation strategies. However, more could be done to enhance the effectiveness of these

institutions and processes. The country has also developed a medium term development framework—the GSGDA, which proposes the mainstreaming of climate change issues into all sectors of the economy. In line with the development framework, sectoral plans are being made 'climate friendly'. Enhancing the institutional mix for climate change mitigation coupled with implementing the vision in the GSGDA policy document have added significance to the nation's LCD work as it would benefit from such improvements.

Having the right mix of institutional structures is part of the building blocks to facilitate sustained implementation of LCD. The ability of Ghana to pursue LCD significantly rest on institutional governance that is workable, efficient and competitive. With the right orientation, capacity and coordination, the institutions would be able to drive LCD effectively within their sectors. However, the institutions are challenged by myriad of interrelated barriers which constrained them from functioning effectively within any LCD framework. The barrier relate to the following aspects: ineffective coordination, capacity and skills, apparent lack of conspicuousness of LCD (specifically) at the high political levels and also at the grassroots stages, inadequate or clear institutional mandate. These factors provide the opportunities to improve the effectiveness in the public institutions in LCD. It will depend largely on Ghana's ability to build on the existing public and government institutions and be able to orient their respective capabilities but with complementary focus on LCD without compromising on their institutional core functions.

10. Future perspective

Insofar as Ghana Government's economic transformation vision seeks to put sustainability at its core; low carbon development strategies will continue to be an integral part of development. The success of integrating LCDs into national development plans will help contribute to Ghana's long term development on a sustainable development trajectory. However, the ability to have LCD in all sectors of the economy and society will require continuous mainstreaming effort at all levels of planning. In the future, the mainstreaming of LCDs will shift beyond planning and formulation and focus on "budgeting toward Monitoring and Evaluation". Having well-coordinated institutions equipped with the right skills to be competitive would be key for this to materialize.

Disclaimer

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Acknowledgement

The authors will like to especially thank current and past staff of the Ministry of Environment, Science, Technology and Innovation (MESTI) for their work in the country report submitted to UNEP DTU Partnership entitled 'Preliminary country study on Institutional Governance for Climate Change Coordination and Implementation in Ghana' which provided invaluable in information for this study. The authors are grateful to the editor and reviewers for their invaluable comments on the

paper. Emmanuel Ackom leads UDP's low carbon development work for Ghana under the FIRM Project. He coordinated the FIRM Ghana project and led the activities in the preparation of this paper, co-authoring with Daniel Benefoh of EPA, Ghana.

Conflict of interest

All authors declare no conflicts of interest in this paper.

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